EFFECT OF MANDIBULAR BODY FRACTURE ON INTERLEUKIN-1β AND C-REACTIVE PROTEIN IN SYNOVIAL FLUID OF TEMPOROMANDIBULAR JOINT

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DEDICATION

TO THE SOUL OF MY LATE PARENTS

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List of Abbreviations

TMJ: Temporomandibular Joint.

TMD: Temporomandibular Disorder.

TMJs: Temporomandibular Joint**s.**

MVAs: Motor Vehicle Accidents.

IL-1β: Interleukin-1Beta.

IL-6: Interleukin-6.

TNFα: Tumor Necrosis Factor Alpha.

ID: Internal Derangement.

OA: Osteoarthritis.

MRI: Magnetic Resonance Image.

MW: Molecular Weight.

KD: kilo Dalton.

IFNs: Interferons.

ILs: Interleukins.

CSFs: Colony Stimulating Factors.

TNF: Tumor Necrosis Factor.

TGF: Transforming Growth Factor.

NK: Natural Killer.

IL-1: Interleukin-1.

MMP: Matrix Metalloproteinase.

CRP: C-Reactive Protein.

PNLs: Polymorph-Nuclear Leucocytes.

PGE_2: Prostaglandin E_2.

LTs: Leukotrienes.

LTB4: Leukotriene B4.

ORIF: Open Reduction and Internal Fixation.

ELISA: Enzyme Linked Immunosorbant Assay.

RTA: Road Traffic Accidents.

GA Unit: General Anesthesia Unit.

MPADSS: Modified Postanaesthetic Discharge Scoring System

I.M: Intramuscular.

Introduction

The present study has been designed to disclose the effect of fracture inducing traumatic injury directed to the mandibular body on non fractured temporomandibular joints (TMJs). Previous researches have clearly discussed the harmful effect of traumatic injuries to parasymphyseal area of mandible on TMJs [(1)]. The momentum inducing fracture of the body of the mandible may persuade indirect injury to TMJs. In such situation the body fracture gains the main concern but the indirectly injured TMJs may be left unnoticed which may result in severe complications.

The degree of damage of joint varies according to magnitude and direction of force, presence or absence of teeth and if the mouth was opened or closed at time of impact. However the pain felt at temporomandibular joint after traumatic injury to the body of the mandible is induced by the release of inflammatory mediators inside the joint space as cytokines and C-reactive protein. [(2, 3)]

Interleukin-1β (IL-1β) is one of the most important cytokines that plays a key role in amplifying inflammation. Interleukin-1β induces several inflammatory events as it activates lymphocytes, stimulates prostaglandin and collagenase production in connective tissue cells and stimulates cartilage proteoglycan breakdown. It also has systemic effects by stimulating the acute phase response, eliciting fever and enhancing muscle protein catabolism. [(4-8)]

C-reactive protein (CRP) is one of acute phase proteins which are synthesized during the general response of the host to trauma, inflammation, infection as well as burns. This response is associated with metabolic changes in the liver in the form of hepatic synthesis of certain proteins such as hepatoglobin, ceruloplasmin, complement components and C-reactive protein, which is termed the acute phase response. [9-13]

Both C-reactive protein (CRP) and interleukin-1β (IL-1β) could be used as calibers for assessment of the responsive inflammatory changes that may occur inside temporomandibular joints after mandibular body fractures. Samples could be collected for analysis by aspiration of synovial fluid from both ipsilateral and contralateral joints at different time intervals.

The obtained results of the present study look forward to change the attitude of surgeons toward indirect trauma directed to temporomandibular joints through body fracture inducing traumatic injury.

Review of literature

Indirect trauma to temporomandibular joints:

Trauma has long been accepted as a major cause of injury to the temporomandibular joint (TMJ) and subsequent temporomandibular disorder (TMD) symptoms. Trauma can be in the form of direct or indirect impact injury, hyperflexion or hyperextension injury. Approximately 25% to 35% of all mandibular fractures involve the condyle, suggesting that severe force is transmitted to this region during some injuries. The possible effects of acute TMJ trauma include ankylosis, traumatic arthritis, intra-articular hemorrhage, stretching of disc ligaments, stretching or tearing of lateral capsule, disc displacement, disc dislocation, adhesions, straining of ligaments and rupture of the posterior attachment. [2, 3, 14-27]

Facial or mandibular trauma when the mouth is in the closed position distributes forces over a large area and is absorbed by the dentition and TMJ. In cases in which the mouth is open or relaxed or there is malocclusion, the forces are transmitted more to the articular structures, muscles and tendons. An opened mouth at the time of impact may result in forces transmitted directly to joint structures which may cause crush injury to disc attachments and collateral ligaments. [2, 3]

Goss and Bosanquet [15] performed superior joint space arthroscopy on bilateral temporomandibular joints (TMJs) in 20 patients with mandibular fractures. The procedure was performed two to ten days after injury. Fifteen of the twenty patients had condylar neck

fractures (4 bilateral) and five patients had body fractures. The most common arthroscopic finding was hemarthrosis with shredding of both the disc and the temporal surface without displacement. The more recently injured joints exhibited more hemarthrosis and capsular hyperemia than those joints in which the arthroscopy was delayed. [2, 15]

The arthroscopic studies showed that when the mandible is fractured, there was generally intra-articular damage to both TMJs. A greater degree of damage was detected on the unfractured side. It has been hypothesized that condylar neck fractures protect the joint from transmitted forces and decrease the degree of intra-articular injury. These findings support the clinical experience that post-traumatic internal derangements are often worse in joints did not have an associated condylar fracture. Arthroscopy has shown that intra-articular injury occurs with mandibular fractures and consists of bleeding into the joint and tearing of the disc and temporal surface. [2, 15, 17, 18]

Hemarthrosis can be managed by early mobilization of jaw and avoiding excessive long standing intermaxillary fixation because this may result in a long term limitation of function. It has been suggested that this limitation in function is due to organization of blood within the joint space leading to synovial hypertrophy and acute inflammation and has been implicated in intra-articular ankylosis [2, 17, 28-33]

Hyperextension and hyperflexion of the cervical spine (cervical whiplash) is a common occurrence during motor vehicle accidents (MVAs). This whiplash phenomenon has been implicated in injuries to the temporomandibular joint in MVAs in which there is no direct

trauma to the mandible. The term "mandibular whiplash" is used for this type of indirect jaw injury. Not only can whiplash produce injury to the soft tissues of the TMJ but it also may aggravate the preexisting internal derangement. [25, 34-44]

Schneider [43] developed an experimental model to suggest simultaneous involvement of the TMJ at the time of cervical whiplash injury. During rear-end collision, there is immediate hyperextension of the cervical spine , which causes posterior rotation of the cranium and a rapid ,involuntary inverted mouth opening as the mandible remains relatively fixed and the cranium and maxilla move away from the mandible. This movement causes hypertranslation of the condyles, which are unprotected anteriorly due to lack of sturdy anterior capsular ligament. Condylar hypertranslation can cause stretching or tearing or both of the retrodiscal tissue and ligaments and may result in disc displacement. If the jaw opens too wide or too fast, some form of disc condyle friction may occur. The speed and amount of movement could be too fast for the synovial fluid in the joint to lubricate the disc properly. Subsequently, high-friction movement could damage the disc, capsule or disc ligaments. [43, 44]

The mandibular whiplash injury often goes unexamined and undiagnosed in many cases because of emphasis on management of the more life-threatening emergencies. In addition to the severe muscle spasm from the direct injury to the muscle, tenderness may occur over C5, C6 and C7 in patients with acute cervical strain. Recent studies have reported on the incidence of TMJ dysfunction in patients who have suffered acute cervical strain. Kronn [45] reported a significantly

higher percentage of joint pain, limited range of motion, masticatory muscle tenderness, and deviation with opening when comparing acute cervical strain patients to controls. [2, 45-47]

Recently it has been reported that variable degrees of inflammation exist in some temporomandibular disorders. Gynther [48] noted that arthroscopic signs of synovitis (capillary hyperemia and synovial hyperplasia) correlated with microscopic findings in synovial biopsy specimens. Quinn and Bazan [49] noted that the levels of prostaglandin E_2 detected in the synovial fluid of inflamed, dysfunctional TMJs had a strong correlation with synovitis and was an index of clinical joint pathology. Takahashi et al [50] noted that several proinflammatory cytokines, including interleukin-1beta (IL-1β), interleukin-6 (IL-6) and tumor necrosis factor α (TNFα) were detectable in patients with internal derangement (ID) and osteoarthritis (OA) of the TMJ, he reported a strong correlation between the detection of IL-1β and pain in the joint area. These data suggest that many inflammatory mediators are contained in synovial fluid from patients with internal derangement and osteoarthritis of the TMJ and also suggest the involvement of these mediators in the pathogenesis of internal derangement and osteoarthritis of the TMJ. Takaku [51] confirmed serious joint effusion in 30 joint spaces that showed high signal intensities on magnetic resonance image (MRI) and demonstrated that the finding of joint effusion suggests the presence of synovitis due to disc damage or degeneration. [47-51]

Capillary hyperemia and synovial hyperplasia will lead to an increase in vascular permeability. It results in the exudation of white